The Effect of the Computer Dictionary and the Paper Dictionary on L2 learners' Vocabulary Acquisition

Najeong Kim
(Seoul National University)

Kim, Najeong. 2003. The effect of the computer dictionary and the paper dictionary on L2 learners' vocabulary acquisition. *SNU Working Papers in English Linguistics and Language 2*, 1-18. This paper investigates the effect of the computer dictionary and the paper dictionary on L2 learners' vocabulary acquisition while reading. Thirty-seven Korean college students divided into a computer dictionary group and a paper dictionary group read a short text for comprehension with access to a dictionary and were tested on the retention of the 14 target words. The results show that (1) while L2 learners read a short text, they look up significantly more words using the computer dictionary than using the paper dictionary, (2) the computer dictionary has a more positive effect on learners' incidental vocabulary acquisition by drawing learners' attention to the words than the paper dictionary, and (3) there is no difference in the retention rate between the words looked up in the computer dictionary and those looked up in the paper dictionary. **(Seoul National University)**

Keywords: paper dictionary, computer dictionary, vocabulary acquisition, attention

1. INTRODUCTION

1.1. Background and Motivation

Within the literature of L1 and L2 acquisition research, it is a widely accepted principle that learners acquire a large number of words incidentally while they read the texts trying to comprehend the texts as a whole. This kind of acquisition, incidental vocabulary acquisition, has been supported by many teachers and researchers, who have argued that reading is an effective and natural way to acquire vocabulary (Krashen, 1989; Nagy, Andersen, & Herman, 1987). However, many researchers have pointed out that reading does not automatically lead to vocabulary learning. It has been argued that in order to acquire

vocabulary while reading, learners have to pay attention to a words meaning and form (Huckin & Coady, 1999; Robinson, 1995; Schmitt, 1990, 2001). In this light, dictionary consultation was proven to be effective in the learners vocabulary acquisition by inducing the learners attention to the word looked up in the dictionary (Hulstijn, Hollander & Greidanus, 1996; Knight, 1994; Luppescu & Day, 1993).

Today, in addition to a traditional paper dictionary, the development of technology brings forth to an alternative consultation tool, a computer dictionary, to the language learners. Due to its convenience, the computer dictionary is gaining popularities among the students in the current L2 education environment. With the increased interest on this new method, many researchers have investigated its effect on L2 learners language learning. However, most of the studies were focused on the effectiveness of the multimedia annotations on vocabulary acquisition and reading comprehension and only a few studies have been conducted on comparing the paper dictionary and the computer counterpart. Yet, no studies were conducted on the effects of a computer dictionary on L2 learners incidental vocabulary acquisition in comparison with a paper dictionary. In this sense, the present study is motivated to explore this issue.

The main aim of this study is to investigate the effect of the two different types of dictionaries, the computer dictionary and the paper dictionary, on L2 learners vocabulary acquisition while they read a text for comprehension.

1.2. Previous Research

1.2.1. Incidental Vocabulary Acquisition

It is widely agreed among language researchers that learners acquire most of their vocabulary while they read for comprehension. This secondary learning is referred to as incidental vocabulary acquisition because it occurs incidentally while learners try to understand the text rather than to acquire vocabulary (Krashen, 1989; Nagy, Andersen, & Herman, 1987). For the last few decades, incidental vocabulary learning has been supported by much evidence in L2 research field.

In spite of the evident role of reading on incidental vocabulary learning, however, many researchers and teachers have pointed out that

learning vocabulary by reading has some limitations.

First of all, readers often ignore unknown words while they read. Reporting a study on the lexical processing strategy training and the strategy use by L2 readers confronting an unfamiliar word, Fraser (1999) analyzed the introspective data from eight participants reading eight texts over 5 months and a recall cued task. From the analysis, she found that the subjects ignored 24% of the unknown words they encounter during reading. In a similar introspective study without strategy training, Paribakht and Wesche (1999) investigated how the readers dealt with the unfamiliar words while they read for meaning. They found that learners ignored 56% of the unknown words in the summary task and 52% in the question task.

Secondly, readers often make incorrect guesses of unfamiliar words and consequently retain incorrect meaning. Incorrect guessing is mostly due to the lack of clear clues in the context and the lack of learners' language proficiency (Huckin & Coady, 1999). Bensoussan and Laufer (1984, cited in Paribakht and Wesche, 1997) reported that many of the target words in a text for adult ESL readers provide no contextual cues to meaning, and that even when existing did not help guessing. Furthermore, learners need to have a large amount of vocabulary and various kinds of knowledge including semantic, syntactic, and morphological knowledge about the words and world knowledge as well.

Thirdly, vocabulary acquisition through reading is not the most efficient way to improve vocabulary under a foreign language learning environment. Learning vocabulary through reading is an increment process. From the first encounter to integration of new lexical knowledge to mental lexicon, learners require repeated exposure to the word. It is presumed that around 5-26.5% of the unknown words are learned by readers in the first encounter (Chun and Plass, 1996; Knight, 1994). For full acquisition, researchers found that learners need 5 to 16 exposures to the target words (Huckin & Coady, 1999). However, L2 learners usually have very limited exposure to the target language.

To overcome these limitations, L2 researchers have suggested some complementary methods to enhance vocabulary learning while reading. They found that provision of glosses and dictionary consultation are effective to promote incidental vocabulary acquisition (Hulstijn, Hollander, & Greidanus, 1996; Knight, 1994; Luppesku & Day, 1993).

Of the two methods, provision of glosses is limited to materials specialized for L2 learners, and thus dictionary use remains a general and useful tool for effective vocabulary learning. Therefore, this study will focus on dictionary use as an effective strategy to improve incidental vocabulary acquisition.

1.2.2. Dictionary Use While Reading

1.2.2.1. The Role of Dictionary Use on Incidental Vocabulary Learning

A number of studies on dictionary use have been conducted to investigate the role of dictionary consultation on incidental vocabulary acquisition while reading. Many L2 researchers found that dictionary consultation enhances incidental vocabulary acquisition. (Fraser, 1999; Hulstijn et al., 1996; Knight, 1994; Laufer & Hill, 2000; Luppescu and Day, 1993)

Knight (1994) investigated whether access to the on-line bilingual dictionary affects vocabulary learning and reading comprehension of American students of Spanish while they read on-line texts. Under two conditions (dictionary and no dictionary), the subjects were asked to read two 250-word texts containing 24 unknown words and then to take a vocabulary test and a recall comprehension test. Two weeks later, a delayed vocabulary retention test was administered. Knight found that the subjects with access to a dictionary learned more words and achieved higher reading comprehension scores than those without access to a dictionary.

In a similar study, Luppescu and Day (1993) examined the effect of the bilingual dictionary on vocabulary learning while 293 Japanese university students of English read a 1,853-word text. After reading, the subjects were asked to take an immediate multiple-choice test on vocabulary. The result showed that the dictionary group scored 50% higher on the vocabulary test than the no-dictionary group. However, they found that using a dictionary decreases reading speed by almost half compared to not using a dictionary.

Hulstijn, Hollander, and Greidanus (1996) studied the influence of marginal glosses, dictionary use, and the re-occurrence of unknown words on incidental vocabulary learning. Seventy-eight Dutch advanced

students of French under three separate conditions (Marginal Glosses, Dictionary Use and No Aid) read a short story. Researchers found that the Dictionary Group who had access to the dictionary while reading yielded much higher retention scores on a subsequent test than the same words in the marginal gloss.

In an introspective study, Fraser (1999) investigated L2 learners lexical processing strategies when they encounter unfamiliar words while reading and the impact of the strategies on vocabulary learning. After a lexical strategy training session, 8 subjects reported their strategy use on eight texts over 5 months and took a delayed recall test measuring vocabulary learning after each reading. It was found that the participants used productive strategies such as inferring, dictionary consulting, and inferring followed by dictionary consulting and that inferring followed by dictionary consulting resulted in more vocabulary learning than inferring or consulting alone.

1.2.2.2. Comparison of the Computer Dictionary Use and the Paper Dictionary Use while Reading

With the advent of computer technology, the computer dictionary appeared as a new convenient consulting device for L2 readers. The computer dictionary provides a different way of consultation to the users. Without flipping through pages and without looking for the spelling in alphabetical order which accompanies traditional dictionary use, electronic dictionary users can access the information in an instant by typing or clicking. (Sharpe, 1995; Nesi, 1996, 1999, 2000b). The advent of the computer dictionary inspired some research on the comparison of look-up behaviors of the computerized dictionary and the paper dictionary.

Roby (1991, cited in Roby, 1999) examined dictionary and gloss use of American students of Spanish reading a biographical sketch. The subjects were divided into four groups: (1) paper dictionary, (2) paper dictionary and gloss, (3) computer dictionary, and (4) computer dictionary and gloss. The factors he measured were reading time, number of look-ups and comprehension. The findings indicate that the subjects with access to the gloss read the passage much faster than those with the dictionary alone. He also found that the subjects with an electronic dictionary looked up much more words than the subjects with a paper

dictionary. However, there was no significant difference on reading comprehension.

In the same line with the comparison studies, Nesi's (2000a) introspective study also focused on look-up behavior, learners' attitude and reading comprehension. The subjects were asked to read two paper-based texts of 286 words each using Oxford Advanced Learner's Dictionary under two conditions: computer condition and paper condition. Data gathered from the subjects were reading time, a self-record sheet of look-up behavior, and a true/false test on comprehension. She found that although there is no significant difference in reading comprehension, the subjects looked up more words when they use a computer dictionary and reported their preference for the computer dictionary and were more satisfied with it.

1.2.3. Noticing Hypothesis

It is widely accepted that incidental vocabulary learning takes place during reading. However, it seems that not all the comprehensible input is likely to be available for further learning processes. In the field of L2 research, many researchers have explored how some parts of the input used for comprehension become activated to be processed further in language learning.

Regarding this issue, Schmidt (1990, 1995, 2001; Schmidt & Frota, 1986, cited in Schmidt, 1990) proposed noticing hypothesis that for learners to learn some aspects of language, they must consciously notice them for any subsequent processing. That is, for input to be intake he claimed that noticing on the part of the learner is necessary. Schmidt defined intake as what Chaudron (1985) called preliminary intake, which means converting speech input into stored data that can be used for the construction of language, distinguishing from those used to organize stored data into linguistic systems (Schmidt, 1990, p. 139). He argued strongly against any intake of input that the learner has not noticed. He meant the term noticing as one of the levels of awareness, at which stimuli are subjectively experienced and attention at the level of the availability of the verbal report. However, he admitted that stimulus events could be noticed even though it could not be describable. In addition, he emphasized the role of consciousness as crucial to all learning, adapting the view of psychology that conscious processing is

necessary for permanent long term storage and anything not processed consciously is not stored in the long-term memory.

1.3. Research Questions

The first aim of this study is to confirm that the computer dictionary would increase learners look-up behavior more than the paper dictionary as found in previous comparison studies. Secondly, this study aims to investigate the effect of the computer dictionary and the paper dictionary on incidental vocabulary learning. According to the previous studies, it was found that dictionary consultation is effective in incidental vocabulary learning (Fraser, 1999; Hulstijn, Hollander, & Greidanus, 1996; Knight, 1994; Luppesku & Day, 1993) and that the computer dictionary encourages the users to look up more words than the paper dictionary (Nesi,2000a; Roby, 1991). Based on these foundings, it is hypothesized that if a computer dictionary increases learners look-up behavior more than its paper counterpart, this will, in turn, result in a more positive effect on incidental vocabulary learning than a paper dictionary. Finally, the third objective of this study is whether the words looked up in the computer dictionary will be retained in memory as well as the words looked up in the paper dictionary. It is hypothesized that learners access the information too quickly and the easily searched words will not be retained in long-term memory.

The research questions to be answered from this research are the following:

(1) Do the computer dictionary users look up more words than the paper dictionary users?

(2) Is the electronic dictionary more beneficial to L2 learners' incidental vocabulary acquisition than the paper dictionary?

(3) Is there any difference on the retention rate between the words looked up in the paper dictionary and the electronic dictionary?

2. Method

2.1. Participants

The participants of the study were 38 undergraduate students enrolled

in two College English classes in the spring semester of 2003 at Seoul National University. All the participants had TEPS scores since they were required to take TEPS before entering the university. Their average TEPS score was 585.6, equivalent to TOEFL 519, TOEIC 640[1].

One class had 22 students and the other had 17. The class consisting of 22 students was assigned to the computer dictionary group and the other class of 17 students to the paper dictionary group. The two groups were not different in English proficiency level, $t = -1.512$, $p = .139$.

In the final statistical analysis, thirty-seven students' data were examined. Two students' data were excluded, for one student in the computer group was absent in one session and the other student in the paper group already knew the meaning of the five target words. Thus, 21 participants remained in the computer dictionary group and 16 in the paper dictionary group. They majored in agriculture and life sciences (18), plant science (1), statistics (1), French education (1), electronic & computer engineering (15) and education (1).

2.2. Materials and Instruments

As for the dictionary, the first edition of the Sisa Elite English-Korean dictionary was selected since the definition contained in the paper dictionary was also provided identically through an Internet site, at http://dic.ybmsisa.co.kr/ ~ybmsisa/s7.php3. The dictionary provides pronunciation, the word category, the Korean equivalents, the tensed forms for the verb and the plural forms for the noun, a few simple examples.

As for the reading material, the text was chosen from a textbook for learners of English as a Second Language (see Appendix A). The following factors were taken into account when selecting the text: text difficulty, text length and familiarity of a topic. The overall difficulty of the text was proven to be adequate for the participants by a pilot test. As for text length, it was quite short, 239 words long, which was appropriate for the purpose of this study since learners tend not to consult the dictionary while reading a long text (Hultijn et. al., 1996).

---

1 TOEFL and TOEIC scores were converted from the TEPS score according to the score correlation table provided by Language Education Institute at Seoul National University.

As for the pre-test, which measures the participants pre-knowledge of the target words, a list of 30 words were made. 20 words were selected from the reading material and 10 words were distracters. The vocabulary items that most participants were unlikely to know were chosen from the selected text. Participants were required to provide the Korean equivalents for the given items. Fourteen words that more than 90% of the participants did not provide the correct meaning for were selected as target words: *affliction, ailment, autopsy, bout, candor, elude, insidious, lesion, malady, mammogram, polio, scourge, susceptibility, telltale* in the alphabetical order. All the target words appeared once in the text.

As for the post-tests, multiple-choice tests were prepared in which the participants were asked to choose a Korean equivalent among 4 alternatives (See Appendix B). A multiple-choice test which can measure the receptive knowledge of the words was considered appropriate to measure the retention of the words gained incidentally from reading, since the probability that the participants can gain word knowledge at the production level at one exposure is very low. The immediate test and the delayed test contained the same items, but in a scrambled order.

2.3. Procedure

The experiment consisted of the pretest, the main session and the delayed test. All the sessions were held during the regular class time and in the regular classrooms with the cooperation of an instructor in charge of the two classes in May 2003.

Before reading the text, the pretest was administered to measure the pre-knowledge of the target words in the presence of the researcher. Based on the result, 14 target words that more than 90% of the respondents did not know were chosen.

In the main session, the participants of the paper group were provided with Sisa Elite English-Korean dictionaries in the classroom. Meanwhile, the participants of the computer group participated in the experiment in a computer lab where they could access the same version of the dictionary through the computer. First, the students were instructed to read the printed text for a comprehension test. The vocabulary test was not announced so that the condition was conducive to incidental vocabulary learning. There was no time limit, but they were advised to read the text within 15 minutes. They were allowed to consult

dictionaries as much as they needed. However, they were asked to underline the words they looked up in the dictionary. After they finished their reading, the reading comprehension test was administered. Then, an unannounced vocabulary test was given. Finally, the participants were asked to respond to the questionnaire. Two days after the main session, a delayed unannounced vocabulary test was given in the presence of the researcher.

2.4. Data Scoring and Analysis

Only the 14 target words in the vocabulary tests were scored by the researcher. With respect to the pretest, a correct answer for each vocabulary item received a score of 1. A half point was given to the answer which reflected partial knowledge of the word and zero points were given to the obviously wrong answer or no response. As for the multiple-choice post vocabulary tests, one point was given to the correct answer and zero points were given to the wrong answer or no response. Thus, a maximum score per participant was 14 points (14 vocabulary items * 1 point).

For the statistical analysis, the Statistical Packages for the Social Sciences (SPSS) 10.0 window version was used. The two-tailed independent t-tests were conducted at the level of .05 to examine the difference between the two groups with respect to all the dependent variables. In order to prevent confusion between the total words looked up and the target words looked up, it is necessary to confirm in advance that the words in this study are restricted to the 14 target words.

3. RESULTS AND DISCUSSION

3.1. The Number of the Words Looked Up

The first aim of this study was to investigate the effect of the two types of dictionaries on the number of the words looked up. To explore this, the words looked up in the dictionary by the participants were analyzed. According to Table 1, the participants of the computer dictionary group looked up the mean number of 11.6 words (82.8% of the target words) while those in the paper dictionary group looked up the average 8.9 words (63.6% of the target words). An independent t-test

revealed that the computer group looked up significantly more words than the paper dictionary group, t = 3.744, p = .001.

This finding is in line with Roby's (1991, cited in Roby, 1999) and Nesi's (2000a) studies. The increased look-up behavior of the computer dictionary group can be explained as the followings: The learners can access the meaning of the words in an instance when they use the computer dictionary. This convenience of the computer dictionary may enhance the learners look-up activities during reading to the extent that the paper dictionary cannot. In contrast to the computer dictionary, the paper dictionary demands more effort and time from the users and often interrupts the flow of reading to a greater extent than the computer dictionary, which, in turn, discourages the readers consultation activities while they read the text.

Table 1
Mean Numbers of the Words Looked Up by Group

Group	n	M	(%)	SD
Computer	21	11.6	(82.8)	1.9
Paper	16	8.9	(63.6)	2.4
Total	37	10.4	(74.3)	2.5

The maximum number of the words looked up = 14

Compared with other studies, the participants of this study looked up a higher percentage of the target words (63.6-82.8%) than those of a similar study by Hultijn et. al. (1996) which showed that the subjects reading the text with the paper dictionary looked up 12 % of the 16 target words. The higher percentage of the present study can be accounted for by such factors as text length, text genre and students proficiency level. It is possible that the text of this study was so short that the participants were more motivated to look up the unfamiliar words than the subjects of Hultijn et. al.'s study (1996) who read much longer text (1,306 word long), as suggested by Hultijn et. al. (1996). Moreover, the text in this study was an expository essay, whereas the text in Hultijn et. al.'s study (1996) was a fictional text. With respect to this point, Hultijn et. al. (1996) argued that this structural difference

between the text genres may cause the words to be more or less relevant to the reading task; thus, can elicit different look-ups. Furthermore, the students with greater vocabulary knowledge look up fewer words than students with smaller vocabulary knowledge (Hultijn, 1993). Thus, it is possible that Hultijn et. al.'s (1996) students who had high verbal ability might look up fewer words than the students of this study who are intermediate level learners.

3.2. The Overall Retention of the Words

The second aim of this study was to explore whether the computer dictionary can be a better aid to L2 learners incidental vocabulary acquisition than the paper dictionary. To explore this issue, the participants score gains between the pretest and the two post vocabulary tests were calculated by subtracting the pretest scores from the post-tests scores.

According to Table 2, in the immediate test, the participants of the computer dictionary group achieved the mean gain score of 9.8 (70%) out of the target words while those of the paper dictionary group gained a mean gain score of 8.1 (57.9%) out of the target words. Later, in the delayed test, the mean gain score of the computer dictionary group was 10.1 (72.1%) of the target words and that of the paper dictionary group was 8.2 (59.3%) of the target words. The result of the independents t-test showed that there are significant differences between the two groups in the immediate and delayed tests, $t = 2.626$, $p = .014$, and $t = 2.369$, $p = .023$, respectively. In conclusion, the learners who used the computer dictionary acquired more vocabulary while they read than the learners who used the paper dictionary.

TABLE 2
Mean Score Gains on the Immediate and the Delayed Vocabulary Tests

Group	n	Immediate Test		Delayed test	
		M (%)	SD	M (%)	SD
Computer	21	9.8 (70)	1.6	10.1(72.1)	2.0
Paper	16	8.1 (57.9)	2.3	8.2 (59.3)	2.7
Total	37	9.1 (65)	2.0	9.3 (66.4)	2.5

The maximum score gain = 14

Compared with Knights (1994) study, the retention of vocabulary of this study is higher than that of Knights study. Knight (1994) found that the students who read the on-line texts consulting the on-line dictionary acquired 51-55% out of the target words on the immediate test and 39-48% on the delayed test. The difference of the percentage between Knights study (1994) and this study might be attributable to the different exposure to the reading material. The participants of this study were allowed to access the reading material during reading comprehension test, whereas Knights participants were not. In addition, in Hulstijn, et al.s study (1996), it was found that advanced level students who read the 1,306-word text with access to the paper dictionary retained 3% of the target words. The low percentage of Hulstijn et al.s study (1996) may be accounted for by the fact that the participants seldom looked up the word (they looked up 12%, as mentioned above), ignoring unfamiliar words while reading, thus; little attention to the words resulted in the low retention of the words.

The following may be the possible explanation about the advantage of the computer dictionary over the paper dictionary on incidental vocabulary learning. In order for the new words to be acquired, the unknown words must be noticed by the learners. According to Schmidt (1990), for the input to be the intake, it must be noticed on the part of the learners. The input ignored is not available for the subsequent learning processes, and thus cannot be acquired. Only the words that the learners pay attention to can be intake which can be acquired through further processes. That is, for the learners to acquire the words, they have to pay attention to the words, but not ignore the words. In this

light, the convenience of the computer dictionary decreases the frequency of ignoring the unfamiliar words and the frequency of deciding not to look up because of time and effort of consultation required for the paper dictionary, but increases the possibility of the learners paying attention to the words by providing the words meaning easily. As a result, this enhances vocabulary acquisition more than the paper dictionary.

Finally, of interest was an unusual finding that the participants of this study gained additional words between the immediate vocabulary test and the delayed test. One possible explanation is that after the immediate test, they were asked to report their look-up behavior in the questionnaire where they had to write down each word they looked up while reading and reported why they looked up. During that procedure, they were exposed to the text and the words once more, which might reinforce their vocabulary learning.

3.3. The Retention Rates of the Words Looked Up

The third major aim of the study was to investigate whether there is any difference in the retention rate between the words looked up in the computer dictionary and those looked up in the paper dictionary. To explore this issue, it was examined how many words the participants in each group remembered among the words they looked up in each dictionary. For each group, the retention rate of the words was obtained by dividing the number of the words remembered among the words looked up by the total number of the target words looked up in the dictionary.

As illustrated in Table 3, in the immediate test, the participants in the computer group remembered 75.9% of the words looked up and those of the paper group retained 76.4% of the words looked up. In the delayed test, the retention rates of the computer group and the paper group were 76.7% and 74.1%, respectively. Independent t-tests showed no significant differences between the two groups both in the immediate test and in the delayed test, $t = -.102$, $p = .921$ and $t = .930$, $p = .359$, respectively.

TABLE 3
Mean Numbers of the Words Looked Up (LU) and the Words Retained from Dictionary Consultation (WR) and Mean Retention Rates (RR) by Group.

The maximum number = 14

Group	N	LU	Immediate Test		Delayed Test	
			WR	RR(%)	WR	RR(%)
Computer	21	11.6	8.8	75.9	8.9	76.7
Paper	16	8.9	6.8	76.4	6.6	74.1
Total	37	10.4	7.9	76.0	7.9	76.0

This finding does not support the hypothesis that the words looked up in the paper dictionary would be retained better than those looked up in the computer dictionary. In addition to the finding that the learners acquire more words using the computer dictionary than using the paper dictionary, the finding that the target words looked up in the computer dictionary were not different in the retention rate from those looked up in the paper dictionary further supports the advantage of the computer dictionary over the paper dictionary.

In comparison with other studies, the retention rate of this study is higher than that of other studies. In Hultijn et. al.'s study (1996), they found that the retention of the 38 words looked up by the students who read a 1,306 word text with access to the paper bilingual dictionary was 22.5 (59%) in the immediate post test which required the subjects to provide the meaning. Thus, the retention rate of the paper dictionary group in the immediate test of this study is comparable with that of Hultijn et. al.'s (1996). The higher retention rate of this study might be due to the different test types and the students further exposure to the text. The test of the present study was a multiple-choice test while that of the Hultijn et. al.'s (1996) was supply-definition test. Furthermore, the participants of the present study took the reading comprehension test with the reading text at their disposal before the vocabulary test, and thus were exposed to the text more than those of the Hultijn et. al.'s study (1996) who did not take the reading comprehension test.

4. CONCLUSION

In the framework of incidental vocabulary acquisition, this paper aims to investigate the effect of the computer dictionary and the paper dictionary on L2 learners vocabulary acquisition while reading. The findings of this study indicate that the learners look up much more words when they use the computer dictionary than when they use the paper dictionary, and as a result, the computer dictionary has a more positive effect on incidental vocabulary learning while reading than the paper dictionary. That is, the convenience of the computer dictionary increases the chances of learners' paying attention to the unfamiliar words by encouraging learners' look-up behavior and consequently the chances of vocabulary acquisition. In addition, it was found that the words looked up in the computer dictionary seem to be remembered as well as the words looked up in the paper dictionary. Thus, it can be concluded that the computer dictionary is more beneficial to L2 learners incidental vocabulary learning than the paper dictionary.

Based on these findings, in order to enhance the students' vocabulary acquisition while reading, the teachers can encourage them to use the computer dictionary. Facing unfamiliar words while they focus on reading for meaning, students tend to ignore unknown words and infer the incorrect meaning, and thus retain the wrong meaning. Therefore, as one of the enhancement methods for vocabulary learning, the teachers can instruct the students to pay attention to unknown words tactically while they read and to use the dictionary critically. That is, the teachers should encourage their students to infer the meaning of the words first, which is the original concept of incidental vocabulary learning, and to consult the dictionary later, by which the learners can gain the correct meaning as a backup for incidental vocabulary learning.

Regarding some limitations of this study, further research is necessary.

First, this study investigated the effects of the computer dictionary on incidental vocabulary learning while reading a short text in an experiment setting. To confirm the conclusions of this study, further studies are needed to investigate the long-term effects of the computer dictionary on language learning compared to the paper dictionary in a natural environment.

Next, further investigations are needed to determine whether the conclusions of this study can be generalized to different types of texts,

different types of dictionaries and different levels of students. In addition, it would be interesting to explore the impact of the pocket-size electronic dictionary on language learning compared to the computer dictionary and the paper dictionary.

Last, the interval between the treatment and the delayed test in this was somewhat shorter than that of the other research on incidental vocabulary acquisition. Thus, future studies need to administer the experiment in a longer span to confirm the conclusion of this study.

References

Bensoussan, M., & Laufer, B. (1984). Lexical guessing in context in EFL reading comprehension. *Journal of Research in Reading, 7*, 15-32.

Chaudron, C. (1985). Intake: on models and methods for discovering learners processing of input. *Studies in Second Language Acquisition* 7, 1-14

Chun, D. M. and Plass, J. L. (1996). Effects of multimedia annotations on vocabulary acquisiton. *The Modern Language Journal, 80,* 183-198.

Fraser, C. A. (1999). Lexical processing strategy use and vocabulary learning through reading. *Studies in Second Language Acquisition, 21,* 225-241.

Huckin, T. and Coady J. (1999). Incidental vocabulary acquisition in a second language: a review. *Studies in second language acquisition, 21,* 181-193.

Hulstijn, J. H., Hollander, M., & Greidanus, T. (1996). Incidental vocabulary learning by advanced foreign language students: The influence of marginal glosses, dictionary use, and reoccurence of unknown words. *The Modern Language Journal, 80,* 327-339.

Knight, S. (1994). Dictionary use while reading: The effects on comprehension and vocabulary acquisition for students of different verbal abilities. *The Modern Language Journal, 78,* 285-299.

Krashen, S. (1989). We acquire vocabulary and spelling by reading: additional evidence for the input hypothesis. *The Modern Language Journal, 73,* 440-464.

Laufer, B. & Hill, M. (2000). What lexical information do L2 learners select in a CALL dictionary and how does it affect word retention? *Language Learning & Technology, 3,* 58-76.

Luppescu, S., & Day, R. R. (1993). Reading, dictionaries, and vocabulary learning. *Language Learning, 43,* 263-287.

Nagy, W. E., Andersen, R. C., & Herman, P. A. (1987). Learning word meanings from context during normal reading. *American Educational Research Journal, 24,* 237-270.

Nesi, H. (1996) Review article: For future reference? Current English learners'

dictionaries in electronic form. *System, 42,* 537-557.
Nesi, H. (1999). A user's guide to electronic dictionaries for language learners. *International Journal of Lexicography, 12,* 55-66.
Nesi, H. (2000a). On screen or in print? Students' use of a learner's dictionary on cd-rom and in book form. In: Howarth, P. and Herington, R. *EAP Learning Technologies* Leeds University Press, 106-114.
Nesi, H. (2000b). Electronic dictionaries in second language vocabulary comprehension and acquisition : the state of the art. In: Held, U., Evert, S., Lehmann, E. and Rohrer, C. (Eds.) *Proceedings of the Ninth EURALEX International Congress, EURALEX 2000 Volume II* Stuttgart: Euralex 839-847.
Paribakht, T. S. & Wesche, M. (1997). Vocabulary enhancement activities and reading for meaning in second language vocabulary development. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition: A rationale for pedagogy* (pp.174-200). New York: Cambridge University Press.
Paribakht, T. S. & Wesche, M. (1999). Reading and Incidental L2 vocabulary acquisition. *Studies in second language acquisition, 21,* 195-224.
Robinson, P. (1995). Attention, memory, and the "noticing" hypothesis. *Language Learning, 45,* 283-331.
Roby, W. B. (1991). Glosses and dictionaries in paper and computer formats as adjunct aids to the reading of Spanish texts by university students. Unpublished doctoral dissertation, University of Kansas.
Roby, W. B. (1999). "What's in a gloss?" *Language Learning & Technology,* 2, 94-101.
Schmidt, R. (1990). The role of consciousness in second language learning. Applied Linguisitics, 11, 129-158.
Schmidt, R. (1995). Consciousness and foreign language learning: A tutorial on the role of attention and awareness in learning. In R. Schmidt (Eds.), Attention and awareness in foreign language learning (pp. 1-63). Honolulu: University of Hawaii Press.
Schmidt, R. (2001). Attention. In P. Robinson (Eds.), *Congition and Second language Instruction* (pp. 3-32). Cambridge. New York: Cambridge University Press.
Schmidt, R. W. & Frota, S. N. (1986). Developing basic conversational ability in a second language: A case study of an adult learner of Portuguese. In R. Day (Eds.), *Talking to learn: Conversation in second language acquisition* (pp. 237-326). Rowley, MA: Newbury House.
Sharpe, P. (1995). Electronic dictionaries with particular reference to the design of an electronic bilingual dictionary for English-speaking learners of Japanese. *International Journal of Lexicography. 8,* 1, 39-54.

Najeong Kim
najeong@hotmail.com